

\*\*\*\*\*  
NATIONAL AERONAUTICS  
AND SPACE ADMINISTRATION  
\*\*\*\*\*

NASA-02515 (June 2004)  
NASA  
Superseding NASA-02515  
(March 2003)  
\*\*\*\*\*

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE CONSTRUCTION

SECTION 02515

WATER SYSTEMS

06/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 LIMITS OF CONSTRUCTION
- 1.4 SHOP DRAWINGS

PART 2 PRODUCTS

- 2.1 PIPING
  - 2.1.1 Cast-Iron/Ductile-Iron Pipe
  - 2.1.2 Pipe Connections
  - 2.1.3 Rubber Gaskets
  - 2.1.4 Reinforced-Concrete Pipe
  - 2.1.5 Copper Tubing
  - 2.1.6 Reinforced Concrete Pipe
  - 2.1.7 Plastic Pipe and Fittings
  - 2.1.8 Steel Pipe
- 2.2 VALVES
  - 2.2.1 Gate Valves
  - 2.2.2 Vacuum and Relief Valves
- 2.3 MISCELLANEOUS ITEMS
  - 2.3.1 Tapped Tees
  - 2.3.2 Corporation Stops
  - 2.3.3 Goosenecks
  - 2.3.4 Service Stops
  - 2.3.5 Service Boxes
  - 2.3.6 Valve Boxes
  - 2.3.7 Valve Manholes
  - 2.3.8 Fire Hydrants
- 2.4 CONCRETE

PART 3 EXECUTION

- 3.1 PIPE HANDLING
- 3.2 CUTTING OF PIPE
- 3.3 LOCATION
- 3.4 DEFLECTION
- 3.5 PLACING, LAYING AND PIPE CONNECTIONS
- 3.6 RUBBER GASKETS

- 3.7 COUPLINGS AND JOINTS
- 3.8 SERVICE LINES
- 3.9 FIRE HYDRANTS, VALVES, AND VALVE BOXES
- 3.10 THRUST BLOCKS
- 3.11 TESTING
  - 3.11.1 Hydrostatic Test
  - 3.11.2 Pressure Test
  - 3.11.3 Leakage Test
  - 3.11.4 Test Timing
  - 3.11.5 Retesting
  - 3.11.6 Sterilizing
- 3.12 PROTECTIVE COATING

-- End of Section Table of Contents --

\*\*\*\*\*  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
NASA-02515 (June 2004)  
NASA  
Superseding NASA-02515  
(March 2003)  
\*\*\*\*\*

SECTION 02515

WATER SYSTEMS  
06/04

\*\*\*\*\*  
NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.  
  
This section covers water supply lines, distribution systems, and connections to building services at a point 5 feet 1500 millimeter outside of buildings and structures to which service is required.  
  
Also included is equipment necessary to provide and test the water system including valves, fittings, and appurtenances as indicated and specified.  
  
Excavation, trenching, and backfilling for utilities is covered under Section 02312 EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES.  
\*\*\*\*\*

PART 1 GENERAL

1.1 REFERENCES

\*\*\*\*\*  
NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.  
\*\*\*\*\*

The publications listed below form a part of this section to the extent referenced:

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (76 mm through 1219 mm), for Water Erratum:

October 1999

AWWA C111	(2000) Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids
AWWA C200	(1997) Steel Water Pipe 6 in. (150 mm) and Larger
AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
AWWA C205	(2000) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop Applied
AWWA C206	(1997) Field Welding of Steel Water Pipe
AWWA C207	(2001) Steel Pipe Flanges for Waterworks Service-Sizes 4 in. Through 144 in.
AWWA C209	(2000) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines
AWWA C220	(1998) Stainless Steel Pipe, 4 in. (100 mm) and Larger
AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C301	(1999) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C302	(1995) Reinforced Concrete Pressure Pipe, Non-Cylinder Type
AWWA C500	(2002; Addendum C500A - 1995) Metal Seated Gate Valves for Water Supply Service
AWWA C502	(1994; Addendum C502A - 1995) Dry-Barrel Fire Hydrants
AWWA C503	(1997) Wet-Barrel Fire Hydrants
AWWA C651	(1999) Disinfecting Water Mains
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in. for Water Distribution
AWWA C901	(2002) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. Through 3 in., for Water

Service

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M (2003) Standard Specification for Carbon Steel Forgings for Piping Applications

ASTM A 589 (1996; R 2001) Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe

ASTM B 88 (2003) Standard Specification for Seamless Copper Water Tube

ASTM B 88M (2003) Standard Specification for Seamless Copper Water Tube (Metric)

ASTM D 1784 (2003) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7005-2 (1988) Metallic Flanges Part 2: Cast Iron Flanges

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (2003) Bronze Gate, Globe, Angle and Check Valves

MSS SP-86 (2002) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

1.2 SUBMITTALS

\*\*\*\*\*  
NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.  
\*\*\*\*\*

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

#### SD-02 Shop Drawings

The following drawing types shall be submitted in accordance with paragraph entitled, "Shop Drawings," of this section.

Erection/Installation Drawings  
As-Built Drawings

#### SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Cast-Iron/Ductile-Iron Pipe  
Pipe Connections  
Rubber Gaskets  
Reinforced Concrete Pipe  
Copper Tubing  
Plastic Pipe and Fittings  
Steel Pipe  
Gate Valves  
Vacuum and Relief Valves  
Tapped Tees  
Corporation-Type Stops  
Goosenecks  
Service Stops  
Service Boxes  
Valve Manholes  
Fire Hydrants

#### SD-06 Test Reports

Test reports for the following items shall be submitted in accordance with the paragraph entitled, "Testing," of this section.

Hydrostatic Test  
Pressure Test  
Leakage Test  
Sterilizing

#### SD-08 Manufacturer's Instructions

Manufacturer's instructions including special provisions required to install equipment, components, and systems packages shall be submitted for the following. Special notices shall detail impedances, hazards and safety precautions.

Pipe Connections  
Rubber Gaskets  
Plastic Pipe and Fittings  
Gate Valves  
Vacuum and Relief Valves  
Tapped Tees  
Corporation Stops  
Service Stops  
Service Boxes  
Valve Manholes  
Fire Hydrants

### 1.3 LIMITS OF CONSTRUCTION

Work in this section relates to excavation, fill, and backfill to a point 5 feet 1500 millimeter beyond the building or structure line.

### 1.4 SHOP DRAWINGS

Erection/Installation Drawings shall be submitted by the Contractor for the complete water system prior to start of work.

As-Built Drawings shall be submitted by the Contractor for the complete water system prior to start of work.

## PART 2 PRODUCTS

### 2.1 PIPING

#### 2.1.1 Cast-Iron/Ductile-Iron Pipe

Ductile-iron pipe shall be in accordance with AWWA C151, Class [50] [51] [52] [53] [54] [55] [56] with [mechanical] [push-on] [\_\_\_\_\_] joints.

Cement-mortar lining shall be in accordance with AWWA C104/A21.4.

Polyethylene encasement shall be in accordance with AWWA C105.

Cast-iron fittings shall be in accordance with AWWA C110.

Cast-iron pipe flanges and flanged fittings shall conform to MSS SP-86, ISO 7005-2, and ASME B16.1.

Flanged and threaded ductile-iron pipe shall be in accordance with AWWA C115.

Coal-tar protective coating shall be in accordance with AWWA C203.

Cement-mortar lining for pipe 4 inches 100 millimeter and larger shall conform to MSS SP-86 and AWWA C205.

Cold-applied tape coating of fittings shall be in accordance with AWWA C209.

Intermediate factory-made joints shall be oversized male and female threaded. Field joints shall be bell-and-spigot with or without factory-made lead joints or oversize male and female threaded type. Pipelines with threaded joints shall be provided with a packing-ring expansion joint at intervals of not more than 108 feet 33 meter.

#### 2.1.2 Pipe Connections

Bolts, nuts, and washers shall be in accordance with the recommendations of the pipe manufacturer.

#### 2.1.3 Rubber Gaskets

Rubber-gasket joints for cast-iron pipe, gaskets, and lubricant shall conform to the applicable requirements of AWWA C111. Gaskets shall be in accordance with recommendations of the pipe manufacturer for steel pipe. Joints for reinforced-concrete pipe shall be the rubber gasket type using [a bell-and-spigot joint design] [a double spigot-and-sleeve joint design of [concrete] [steel]]. Joints shall be so designed that, when the pipe is

laid and the joint completed, the gasket will be completely enclosed. Rubber gaskets shall be the sole element depended upon for water tightness. Gaskets shall be continuous rings of the necessary size and cross section to fill the recess provided and shall conform to the recommendations of the pipe manufacturer, as applicable. Connections between cement pipe and cast-iron fittings or gate valves shall be made with [jointing materials for cast-iron pipe] [approved materials recommended by the pipe manufacturer].

#### 2.1.4 Reinforced-Concrete Pipe

Steel-cylinder reinforced-concrete pipe shall conform to [AWWA C300] [AWWA C301], and shall be designed to withstand a minimum working pressure of 150 pounds per square inch (psi) 1050 kilopascal. Non-cylinder Reinforced Concrete Pipe shall conform to AWWA C302, and shall withstand a minimum working pressure of 45 psi 310 kilopascal. Joint rings shall be protected by cement grouting.

#### 2.1.5 Copper Tubing

Copper tubing shall conform to ASTM B 88 ASTM B 88M, Type K, annealed. Joints for underground work shall be compression pattern, flared, for soft copper water tubing, and shall be made with approved fittings. Tubing shall be cut off square and expanded with a proper flaring tool.

#### 2.1.6 Reinforced Concrete Pipe

Fittings and special sections required for closures, curves, bends, branches, and connections to valves, pipe, or structures shall conform to [AWWA C300] [AWWA C301] [AWWA C302].

#### 2.1.7 Plastic Pipe and Fittings

Solvent weld pipe shall be extruded of an improved polyvinylchloride (PVC) virgin pipe compound. Compound shall conform to ASTM D 1784, Cell Classification 12454-B, and have a [2,000] [14] [\_\_\_\_\_] psi Megapascal hydrostatic design stress rating. Pipe and fittings shall conform to [AWWA C900] [AWWA C901], Schedule [40] [80].

Pipe shall bear the following markings: manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi [Megapascal] [kilopascal], and NSF (National Sanitation Foundation) marking. Manufacturer shall also mark the date of extrusion on the pipe.

Solvent cement or rubber-gasket joints for pipe and fittings shall be in accordance with the manufacturer's instructions.

Fittings shall be PVC Schedule [40] [80].

Fittings shall be injection-molded of an improved PVC compound. Fittings shall conform to ASTM D 1784, Cell Classification 12454-B.

Tees and ells shall be side gated.

Fittings shall bear the company's name and trademark, material designation, size, applicable iron pipe size (ips) schedule, and NSF seal.

Threaded nipples shall be standard weight Schedule 80 with molded threads.



#### 2.1.8 Steel Pipe

Steel pipe (6 inches DN150 and larger) shall be in accordance with ASTM A 589, AWWA C200, and AWWA C220, Schedule [40] [80].

Steel flanges shall conform to MSS SP-86, AWWA C207 and ASTM A 105/A 105M.

Field welding of steel pipe shall be in accordance with AWWA C220, ASTM A 589, and AWWA C206.

### 2.2 VALVES

#### 2.2.1 Gate Valves

Valves shall be designed for a minimum of 150 psi 1050 kilopascal. Valves shall have [bell-and-spigot ends] [screw joints]. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. Operating nut or wheel shall have an arrow cast in the metal indicating the direction of opening. Valves smaller than 3 inches DN75 shall be all bronze and shall conform to MSS SP-86 and MSS SP-80, Type I. Valves 3 inches DN75 and larger shall be iron-body, brass-mounted, conforming to MSS SP-86 and AWWA C500.

#### 2.2.2 Vacuum and Relief Valves

Vacuum and relief valves shall be size and type to relieve pressure and prevent the formation of a vacuum. Valves shall automatically remove air from the lines when the lines are being filled and admit air into the lines when water is being withdrawn in excess of the inflow.

### 2.3 MISCELLANEOUS ITEMS

#### 2.3.1 Tapped Tees

Tees shall be installed as necessary.

#### 2.3.2 Corporation Stops

Corporation stops shall have waterworks standard thread on the inlet end, with flanged-joint couplings or wiped joints for connections to goosenecks.

#### 2.3.3 Goosenecks

Copper tubing for gooseneck connections shall be in accordance with ASTM B 88 ASTM B 88M, Type K, annealed.

#### 2.3.4 Service Stops

Service stops shall be waterworks ground-key type, oval flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. Parts shall be cast red brass having a nominal composition of 85-percent copper, 5-percent tin, 5-percent lead, and 5-percent zinc, with female (ips) connections designed for a minimum pressure of [200] [1400] [\_\_\_\_\_] psi. kilopascal.

#### 2.3.5 Service Boxes

[Service boxes shall be [cast iron] [concrete]. Extension service boxes of the required length, having either screw or slide adjustment, shall be

installed at service-box locations. Boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers. Where water mains are located in streets having curbs, boxes shall be located directly back of the curbs. Where no curbing exists, boxes shall be in accessible locations beyond the limits of streets, walks, and driveways.]

#### 2.3.6 Valve Boxes

[Valve boxes shall be [cast iron] [concrete], complete with lock-type covers requiring a special wrench for removal. Cast-iron boxes shall be the extension type with screw or slide adjustments and with flared bases. Concrete boxes shall be constructed in accordance with details indicated. The word "WATER" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Concrete boxes may be installed only in locations not subjected to traffic.]

#### 2.3.7 Valve Manholes

Valve manholes shall be constructed in accordance with the details indicated.

#### 2.3.8 Fire Hydrants

Fire hydrants shall be in accordance with [AWWA C502, for dry-barrel type fire hydrant] [AWWA C503, for wet-barrel type fire hydrant]. Hydrants shall have a 6-inch DN150 bell connection, two 2-1/2-inch DN65 hose connections, and one 4-1/2-inch DN115 pumper connection. Outlets shall have American National fire-hose coupling threads. Working parts shall be bronze. Hydrants shall be connected to the mains with 6-inch DN150 diameter pipes. Hydrants shall be painted with [one] [\_\_\_\_\_] coat[s] of zinc-chromate alkyd paint primer and [two] [\_\_\_\_\_] finish coats of approved paint of the color required.

#### 2.4 CONCRETE

Concrete for thrust blocks shall be a minimum of [3,000] [21] [\_\_\_\_\_] psi Megapascal.

### PART 3 EXECUTION

#### 3.1 PIPE HANDLING

Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. When the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried into position. Use of pinch bars and tongs for aligning or turning the pipe shall be permitted only on the bare ends of the pipe. Interior of pipe and accessories shall be cleaned before being lowered into the trench and shall be kept clean during laying operations by an approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional cost to the Government. Rubber Gaskets that are not to be installed immediately shall be stored in a cool dark place

out of the direct rays of the sun.

### 3.2 CUTTING OF PIPE

Cutting of pipe shall be done without damage to the pipe. Cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical.

### 3.3 LOCATION

Where the location of the water pipe is not clearly defined by dimensions, the water pipe shall be laid not closer than [10] [3] [\_\_\_\_\_] feet meter from a sewer horizontally, except where the bottom of the water pipe will be at least [18] [450] [\_\_\_\_\_] inches millimeter above the top of the sewer pipe, in which case the water pipe shall be laid not closer than 6 feet 1800 millimeter from the sewer horizontally. Where waterlines cross under gravity flow sewer lines, the sewer pipe for a distance of at least [10] [3] [\_\_\_\_\_] feet meter each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within [3] [1] [\_\_\_\_\_] feet meter, horizontally, of the crossing. Waterlines shall, in all cases, cross above sewage force mains or inverted siphons and shall be not less than [2] [600] [\_\_\_\_\_] feet millimeter above the sewer main. Joints in the sewer main closer horizontally than [3] [1] [\_\_\_\_\_] feet meter, to the crossing shall be encased in concrete. Waterlines shall not be laid in the same trench with gas lines, fuel lines, or electrical wiring.

### 3.4 DEFLECTION

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for cement or reinforced-concrete pipe. Maximum allowable deflection for cast-iron bell-and-spigot pipe and mechanical-joint pipe, shall be as recommended by the manufacturer.

When the alignment requires deflections in excess of the manufacturer's recommendations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved. Long-radius curves in reinforced-concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated special sections.

Where PVC pipe is used, a single conductor No. 14 AWG 1.6 millimeter thick wire with Type TW insulation shall be installed above the pipe to facilitate pipe location.

### 3.5 PLACING, LAYING AND PIPE CONNECTIONS

Pipe and accessories shall be carefully lowered into the trench by suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be made of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. Full length of each section of pipe shall rest solidly upon the pipe bed, with

recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid.

Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that foreign material will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor in an approved manner, at no additional expense to the Government.

Pipe ends left for future connections shall be valved, plugged, or capped and anchored. Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings to suit the actual conditions. Where made under pressure, connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped.

Before laying reinforced-concrete pipe, the outside surface of the spigot and the inside surface of the bell shall be cleaned, and an approved lubricant shall be applied to the inside surface of the bell and to the rubber gasket. Where recommended by the manufacturer of the pipe, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gage in accordance with the pipe manufacturer's recommendations. Tapping into reinforced-concrete cylinder pipe shall be done in accordance with the manufacturer's recommendations. Where the manufacturer recommends that the taps be made by attaching the rubber-gasketed saddle to the outside of the pipe using U-bolts, the saddle shall be grouted in when necessary. Mortar coating shall be chipped away until even with the hole in the saddle plate, and the exposed circumferential wires removed. Cylinder and concrete core shall be drilled out, and the steel saddle and U-bolts shall be protected by concrete encasement.

### 3.6 RUBBER GASKETS

Rubber gaskets shall be handled, lubricated, and installed in accordance with the pipe manufacturer's recommendations. Outside annular space between abutting sections of concrete pipe shall be filled with cement mortar. When recommended by the manufacturer, the inside annular joint space shall be filled with cement mortar after backfilling has been partially accomplished.

### 3.7 COUPLINGS AND JOINTS

Joints for Copper Tubing shall be compression pattern, flared, for soft copper water tubing and shall be made of approved fittings. Tubing shall be cut off square and expanded with an acceptable flaring tool. Installation of couplings and mechanical joints shall be in accordance with the manufacturer's recommendations. Pipe Connections between different types of pipe and accessories shall be made with transition fittings as recommended by the manufacturer.

### 3.8 SERVICE LINES

Service lines shall include the lines to and connections with, the building service at a point [5] [1500] [\_\_\_\_\_] feet millimeter outside the building.

Where building services are not installed, the Contractor shall terminate the service lines [5] [1500] [\_\_\_\_\_] feet millimeter from the site of the proposed building at the point designated. Such service lines shall be

closed with plugs or caps. Service Stops and Gate Valves shall be provided with extension boxes of the lengths required by the depths of service line stops or valves. Service lines shall be constructed in accordance with the following: service lines 1-1/2 inches 40 millimeter and smaller shall be connected to the main by a Corporation-Type Stops and a copper gooseneck, with a service stop below the frostline. Two-inch Fifty millimeter service lines shall be connected to the main with a rigid connection or a corporation-type stop and copper gooseneck and a gate valve located below the frostline. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard quality branch connections in conformance with recognized standard practice. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply. Service lines larger than 2 inches 50 millimeter shall be connected to the main by a rigid connection and shall have a gate valve located below the frostline.

### 3.9 FIRE HYDRANTS, VALVES, AND VALVE BOXES

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Each hydrant shall be connected to the main with a 6-inch 150 millimeter branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway, the center of the lowest outlet not less than [18] [450] [\_\_\_\_\_] inches millimeter above the finished surrounding grade, and the operating nut not more than 4-feet 1200 millimeter above the finished grade. At least [7] [0.2] [\_\_\_\_\_] cubic feet meter of broken stone shall be placed around the base of the hydrant to ensure drainage. Backfill around the hydrant shall be compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practicable. Hydrant shall be set on a slab of concrete not less than [4] [100] [\_\_\_\_\_] inches millimeter thick and [15] [380] [\_\_\_\_\_] inches millimeter square. Valves and valve boxes shall be set plumb. Valve boxes shall be centered on the valves. Valves shall be located outside the area of sidewalks, roads, streets, and parking areas. Earth fill shall be carefully tamped around each valve box [to a distance of 4 feet 1200 millimeter on all sides of the box] [to the undisturbed trench face if less than 4 feet 1200 millimeter]. Stuffing boxes shall be tightened, and the hydrants and valves shall be inspected in open and closed positions to ensure that all parts are in working condition.

### 3.10 THRUST BLOCKS

Plugs, caps, tees, bends deflecting 22-1/2 degrees or more on mains 8 inches 200 millimeter in diameter or larger, and fire hydrants shall be provided with concrete thrust blocks. Blocks shall be placed between solid ground and the hydrant or fitting to be anchored. Blocks shall be so placed that fitting joints will be accessible for repair.

### 3.11 TESTING

#### 3.11.1 Hydrostatic Test

Hydrostatic-pressure test shall be made no sooner than [72] [\_\_\_\_\_] hours after installation of thrust blocks.

#### 3.11.2 Pressure Test

After the pipe is laid, the joints completed, the fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed

for examination, the newly laid piping or any valved section of piping shall be subjected for [1] [\_\_\_\_\_] hour to a hydrostatic-pressure test of [200] [1400] [\_\_\_\_\_] psi kilopascal. Mains supplying water to individual buildings for fire protection shall be subjected for [2] [\_\_\_\_\_] hours to a hydrostatic-pressure test of [200] [1400] [\_\_\_\_\_] psi kilopascal. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be remade using new gaskets when necessary. Pipe, mechanical joints, fittings, valves, or hydrants discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

### 3.11.3 Leakage Test

Leakage tests shall be conducted after the pressure test has been approved.

Duration of each leakage test shall be at least [2] [\_\_\_\_\_] hours. During the test, the main shall be subjected to a pressure of [200] [1400] [\_\_\_\_\_] psi kilopascal. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

[Allowable leakage in gallons liter per hour per joint at [200] [1400] [\_\_\_\_\_] psi kilopascal average test pressure shall be as follows:

<u>PIPE DIAMETER (INCHES)</u>	<u>ALLOWABLE LEAKAGE (GALLONS PER HOUR)</u>
2	0.0153
3	0.0230
4	0.0306
6	0.0458
8	0.0610
10	0.0765
12	0.0915
14	0.1070
16	0.1225
18	0.1375
20	0.1530
24	0.1830
<u>PIPE DIAMETER (DN)</u>	<u>ALLOWABLE LEAKAGE (LITRE PER HOUR)</u>
50	3.47

<u>PIPE DIAMETER (DN)</u>	<u>ALLOWABLE LEAKAGE (LITRE PER HOUR)</u>
75	5.22
100	6.95
150	10.40
200	13.85
250	17.37
300	20.78
350	24.30
400	27.82
450	31.22
500	34.75
600	41.56

[Allowable leakage in gallons liter per hour not exceed [1] [5] [\_\_\_\_\_] percent of total system pressure.]]

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

#### 3.11.4 Test Timing

Except where concrete-reaction backing necessitates a [72] [\_\_\_\_\_] -hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill. Concrete pipe shall be filled with water for at least [24] [\_\_\_\_\_] hours before being subjected to the pressure test and subsequent leakage test.

#### 3.11.5 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

#### 3.11.6 Sterilizing

Water piping, including valves, fittings, and other devices, shall be sterilized and tested according to AWWA C651. After successful sterilization, the piping shall be flushed before placing into service. Water for sterilization will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

#### 3.12 PROTECTIVE COATING

Exposed portions of steel joint rings of reinforced-concrete pipe shall be protected from corrosion by a metallic coating, or by a nonmetallic coating when approved.

-- End of Section --